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Computer aided data conversion method for exposure processing data of electron beam system - dividing execution data for exposure processing among networked computer terminals based on each computer's load
NoAbstract

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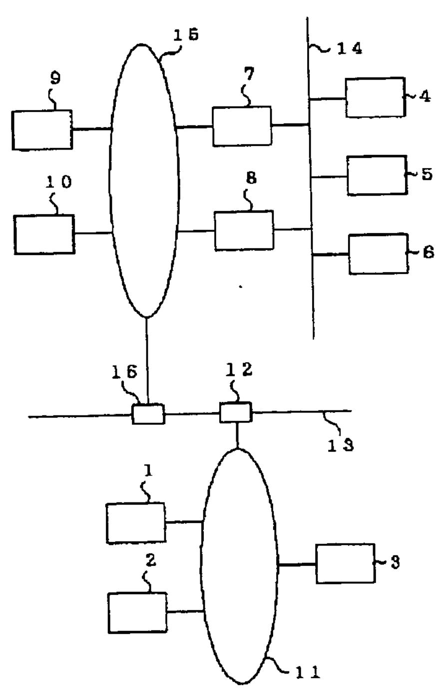
(54)【発明の名称】　荷電粒子線露光装置のデータ変換方法

(57)【要約】

【目的】　露光処理データから実行データへの変換を効率良く行なって、露光処理データ作成用の設計支援装置から露光装置に至るまでのライン全体の効率を向上させ得るデータ変換方法を提供する。

【構成】　CAD計算機1～3で作成した露光処理データを電子ビーム露光装置4～6が要求する実行データに変換する過程を複数の連続した単位処理に分割する。露光処理データを、CAD計算機1～3から電子ビーム露光装置4～6に至る間でネットワーク状に接続された複数の計算機資源1～10の間で転送しつつ分割された単位処理を最初から順に実行する。データの転送時には、残された単位処理の数と各計算機資源1～10の配置および負荷とに基づいて次の単位処理を実行すべき計算機資源を特定し、当該計算機資源にデータを転送する。



【特許請求の範囲】

【請求項１】　設計支援装置で作成した露光処理データを、荷電粒子線露光装置で露光処理を行なうための実行データに変換する荷電粒子線露光装置のデータ変換方法であって、

前記露光処理データから前記実行データへのデータ変換過程を複数の連続した単位処理に分割し、

前記設計支援装置と前記荷電粒子線露光装置との間でネットワーク状に接続された複数の計算機資源により、前記分割された単位処理を順に実行しつつデータを転送して前記荷電粒子線露光装置に実行データを供給し、

前記データの転送時には、残された単位処理の数と各計算機資源の配置および負荷とに基づいて次の単位処理を実行すべき計算機資源を特定し、当該計算機資源にデータを転送することを特徴とする荷電粒子線露光装置のデータ変換方法。

【請求項２】　前記データの転送時には、残された単位処理の数と各計算機資源の配置とに基づいて転送候補となる計算機資源群を選び出し、この計算機資源群内の各計算機資源の負荷を比較して負荷が小さい計算機資源にデータを転送することを特徴とする荷電粒子線露光装置のデータ変換方法。

【請求項３】　前記実行データが前記荷電粒子線露光装置のバッファメモリに格納されるように転送制御されることを特徴とする請求項１または２記載の荷電粒子線露光装置のデータ変換方法。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、設計支援装置で作成した露光処理データを、電子ビーム露光装置に代表される荷電粒子線露光装置に適したデータに変換する方法に関する。

【０００２】

【従来の技術】ＬＳＩ設計用のＣＡＤシステムで作成したパターンデータに基づいて電子ビーム露光装置で試料上にＬＳＩパターンを露光する場合、ＣＡＤシステムで作成したパターンデータの書式を電子ビーム露光装置が要求するデータの書式に変換する作業が必要である。図６はパターンデータの作成から露光までの手順の一例を示すフローチャートである。この例では、ステップＳ１でＣＡＤシステムによりパターンデータを作成し、ステップＳ２でパターンデータの書式をＣＡＤシステム自身またはデータ変換用の計算機によって電子ビーム露光装置用の書式に変換し、ステップＳ３で変換後のパターンデータを一括して露光装置へ転送する。転送されたデータは露光装置のバッファメモリに格納され、ステップＳ４で露光処理が実行される。

【０００３】ここで、電子ビーム露光装置で露光を行なう場合には、露光パターンの精度を向上させるため、書式変換時（ステップＳ２）に線幅のリサイズ、スケーリング、近接効果の補正等の電子ビーム露光装置に特有の補正処理が一括して行なわれ、これらの補正処理と上述した書式変換とを総合して一般にパターンデータのデータ変換と呼んでいる。このデータ変換は幾つかの段階に分けて処理されることが通例で、データ変換用の計算機はデータ変換処理が一定段階進行する毎に中間ファイルへデータの書込みを行ない、すべての処理が終了した時点で露光装置へデータを一括転送する。本明細書では、データ変換を行なう前のデータを露光処理データ、データ変換後のデータを実行データと称して区別する。

【０００４】

【発明が解決しようとする課題】上述したように特定のデータ変換用計算機で集中的にデータ変換を行なった場合、ＬＳＩのパターンデータのデータ量が多いため、データを中間ファイルへ書込み、あるいはデータを読み出すための入出力時間がデータ変換時間に比べて著しく長くなり、データ変換処理の効率が極めて低くなる。ちなみに、データ入出力時間がデータ変換時間の４倍程度となることも稀ではなかった。電子ビーム露光装置は、微細パターンの描画に優れる一方で露光時間が長くなるという特性から、特定用途向けの専用ＬＳＩや先端デバイスの試作、あるいは一括方式の露光装置で使用するマスクやレチクルの露光など少量多品種の露光に使用されることが多い。このため、露光処理データから実行データへのデータ変換は頻繁に行なわれ、上述したデータ入出力時間によるオーバヘッドは、ＣＡＤシステムから露光装置に至るライン全体の効率を著しく低下させる。

【０００５】本発明の目的は、露光処理データから実行データへの変換を効率良く行なって、露光処理データ作成用の設計支援装置から露光装置に至るまでのライン全体の効率を向上させ得るデータ変換方法を提供することにある。

【０００６】

【課題を解決するための手段】一実施例を示す図１および図４を参照して説明すると、本発明では、露光処理データから実行データへのデータ変換過程を複数の連続した単位処理Ｕ１～Ｕ５に分割し、設計支援装置１～３と荷電粒子線露光装置４～６との間でネットワーク状に接続された複数の計算機資源１～１０により分割された各単位処理Ｕ１～Ｕ５を順に処理しつつデータを転送して荷電粒子線露光装置４～６に実行データを供給する。そして、データの転送時には、残る単位処理の数と各計算機資源１～１０の配置および負荷とに基づいて次の単位処理を実行すべき計算機資源を特定し、当該計算機資源にデータを転送することにより、上述した目的を達成する。データを転送すべき計算機資源の特定方法としては、請求項２の変換方法のように、残された単位処理の数と計算機資源１～１０の配置とに基づいて転送候補となる計算機資源群を選び出し、この計算機資源群内の各計算機資源の負荷を比較して負荷が小さい計算機資源に

データを転送する方法を用いることができる。変換された実行データは、請求項３に記載のように荷電粒子線露光装置４～６のバッファメモリに格納することができる。

【０００７】

【作用】設計支援装置１～３で露光処理データが作成されると、この露光処理データが分割された単位処理Ｕ１～Ｕ５にしたがって順に実行データへ向けて変換されつつ、設計支援装置１～３と荷電粒子線露光装置４～６との間をネットワーク状に結ぶ計算機資源１～１０の間で転送され、最終的に荷電粒子線露光装置４～６へ実行データが供給される。負荷が小さい計算機資源がデータの転送先として選ばれるので、設計支援装置１～３から荷電粒子線露光装置４～６に至る各計算機資源の負荷が平均的に分散される。

【０００８】なお、本発明の構成を説明する上記課題を解決するための手段と作用の項では、本発明を分かり易くするために実施例の図を用いたが、これにより本発明が実施例に限定されるものではない。

【０００９】

【実施例】以下、図１～図５を参照して本発明の一実施例を説明する。図４は本実施例に係るＬＳＩパターン形成のためのリソグラフィー生産ラインを示すものである。この生産ラインは、露光処理データを作成する３台のＣＡＤ計算機１～３と、露光処理を行なう３台の電子ビーム露光装置４～６と、これら電子ビーム露光装置４～６で露光を行なうために必要な諸データを管理する２台の露光用データ管理計算機７，８と、生産ライン全体を管理する２台の生産ライン管理計算機９，１０とを備えている。露光用データ管理計算機７，８は例えばデータベースエンジンを搭載した汎用のワークステーションにより構成されるが、生産ライン管理計算機９，１０や電子ビーム露光装置４～６自身の制御装置で兼用してもよい。

【００１０】ＣＡＤ計算機１～３は生産現場から離れたデザインルームに設置され、イーサネット１１により相互に接続されるとともに、ブリッジ１２を介してイーサネット幹線１３に接続される。一方、電子ビーム露光装置４～６は生産現場のクリーンルーム内に設置され、それぞれのバッファメモリと露光用データ管理計算機７，８との間はＶＭＥバス１４で相互に接続される。露光用データ管理計算機７，８および生産ライン管理計算機９，１０はクリーンルーム内またはその周囲に設置され、イーサネット１５によって相互に接続されるとともに、ブリッジ１６を介してイーサネット幹線１３に接続される。以上により、ＣＡＤ計算機１～３、電子ビーム露光装置４～６、露光用データ管理計算機７，８および生産ライン管理計算機９，１０の１０台の計算機資源が相互にネットワーク状に接続される。

【００１１】各計算機１～１０は露光処理データの変換

を行なうため、図５に示す論理構成を備える。図において２０はネットワーク状に接続された計算機１～１０の間でのデータの受け渡しを制御する転送制御部である。この転送制御部２０がデータを受取るとデータ処理部２１にデータが供給され、後述するデータ変換処理のうち所望の処理が実行される。データ処理部２１で処理されたデータは、転送制御部２０により転送先決定部２２で決定された転送先に転送される。転送先決定部２２は、転送経路探索部２３が探索した転送経路と、負荷測定部２４が測定した計算機１～１０の負荷とに基づいて転送先を決定する。転送経路探索部２３は、計算機１～１０の接続形態とデータ処理部２１から供給される残りの単位処理数とに基づいて転送経路を探索する。負荷測定部２４は、例えば計算機１～１０のＣＰＵの一定時間における稼働率から各計算機１～１０の負荷を測定する。

【００１２】次に、図１～図３を参照して本実施例のデータ変換手順を説明する。本実施例では、ＣＡＤ計算機１～３のいずれかで作成した露光処理データを電子ビーム露光装置４～６が要求する実行データへ変換するための処理を、図１に示すように複数の連続した単位処理Ｕ１～Ｕ５に分割する。最初の単位処理Ｕ１ではＣＡＤ計算機１～３で作成した露光処理データの書式をデータ変換に適した書式に変換し、２番目の単位処理Ｕ２ではパターンの重なり除去、斜線処理、スケーリングおよびリサイズを行ない、３番目の単位処理Ｕ３ではパターンのサブチップ分割および矩形分割を行ない、４番目の単位処理Ｕ４では近接効果補正を行なう。そして、最後の単位処理Ｕ５では、変換されたデータの書式を露光装置４～６が要求する書式へ変換する。これらの単位処理Ｕ１～Ｕ５で構成される一作業はジョブと呼ばれる。本実施例ではジョブの進行状況を示すパラメータとして処理番号が設定され、この処理番号と上述した単位処理Ｕ１～Ｕ５との対応付けは各計算機（以下ノードとも呼ぶ）１～１０で統一され共有されている。例えば任意のノードが処理番号「００１」のジョブを受取ったならば単位処理Ｕ１を実行し、処理番号「００４」のジョブを受取ったならば単位処理Ｕ４を実行するように各ノードに統一した定義が与えられる。

【００１３】図２にジョブの処理の流れを示す。ＣＡＤ計算機１～３のいずれかで露光処理データが作成されるとジョブの処理が開始される。露光処理データを作成したＣＡＤ計算機１～３はステップＳ１１で後述する転送先探索処理を行ない、ステップＳ１２で決定された転送先へジョブを転送する。このとき上述した処理番号は最初の単位処理Ｕ１に対応した数に設定される。

【００１４】転送先のノードｎ１は、まずステップＳ１００でジョブを受取る。ついで、ステップＳ１０１で受取ったジョブの処理番号に対応する単位処理を実行し、ステップＳ１０２で処理番号を次の単位処理に対応する処理番号へ更新する。そして、ステップＳ１０３で転送

先を探索し、ステップS１０４でジョブを転送する。新たな転送先のノードｎ２は、先のノードｎ１と同様にジョブ受取りからジョブ転送までの処理を実行し、以下最後の単位処理Ｕ５が終了するまで同様にデータ変換および転送が繰り返され、最後の単位処理Ｕ５までデータ変換が進行すると露光装置４～６のいずれかにジョブが転送される。最終的な転送先である露光装置４～６で実行されるステップＳ１３はバッファメモリへの格納を意味し、ステップＳ１４で露光処理を行なう。

【００１５】上記の転送先探索処理を図３および図５に基づいて説明する。図３は、データ変換処理が単位処理Ｕ２を終えた段階、すなわちあと３つの単位処理Ｕ３～Ｕ５を実行するとジョブが完了する状態を有向グラフで示すものである。各ノードは、その機能によりソースノードＡ、中間ノードＢ，ＣおよびシンクノードＤ，Ｅに区分される。ソースノードＡは現時点でジョブを所有しているノードであり、１つのジョブに対して１つだけ存在する。例えば、ＣＡＤ計算機１で露光処理データを作成した段階ではＣＡＤ計算機１自身がソースノードＡとなる。シンクノードＤ，Ｅはジョブの終着点であり、本実施例では電子ビーム露光装置４～６、より詳しくは露光装置４～６のパターンデータ格納用のバッファメモリが該当する。ソースノードＡおよびシンクノードＤ，Ｅを除くノードが中間ノードＢ，Ｃとなり、これら中間ノードＢ，ＣおよびシンクノードＤ，Ｅは複数設定可能である。

【００１６】図３の状態から転送先を決定するには、まずソースノードＡの転送経路探索部２３が、データ処理部２１から送られるジョブの処理番号によって残された単位処理数を判断し、かかる処理数と各ノードの配置から残る処理数以下の転送回数でジョブをシンクノードＤ，Ｅまで転送できる全ての経路を抽出する。この際、有向グラフであるため、必ず先行節から後行節へと繋がるように経路が作成される。これには位相整列（トポロジカルソート）として周知のアルゴリズムが適用できる。

【００１７】図３の場合、残りの単位処理数が３つであるから、２回の転送でシンクノードＤ，Ｅに到達する経路と、３回の転送でシンクノードＤ，Ｅに到達する経路とが抽出される。前者としてはABD, ABE, ACD, ACEの４経路が、後者としてはABCD, ABCE, ACBD, ACBEの４経路が抽出される。ここで、２回の転送でシンクノードＤ，Ｅに到達する経路ABD, ABE, ACD, ACEは、経路上のいずれかのノードで自分自身へジョブを転送することを意味する。経路ABDならば、実際にはAABD, ABBD, ABDDのいずれかの経路でデータの処理、転送が行なわれる。

【００１８】以上の経路抽出を終えたならば、ソースノードＡの負荷測定部２４で測定される各ノードの負荷のうち、転送候補となるノード群、図の例ではノードＡ，Ｂ，Ｃの負荷を転送先決定部２２で相互に比較する。そして、最も負荷が小さいノードを転送先として決定し、データ処理部２１で処理されたジョブを転送制御部２０から転送先へ向けて送り出す。

【００１９】本実施例では、分割された単位処理Ｕ１～Ｕ５を順に実行しつつＣＡＤ計算機１～３から電子ビーム露光装置４～６へ向けてデータを転送して行くので、特定の計算機で集中的にデータ変換を行なった後に、データを一括して転送する従来例と比較した場合、データの入出力時間が無駄時間とならず、データ変換効率が高まる。また、例えばＣＡＤ計算機１～３から隣接する計算機７～１０へデータを転送した後は、新たな露光処理データの作成やデータ変換処理をＣＡＤ計算機１～３で実行できるというように、複数のデータをパイプライン式に並列処理できるので、ライン全体の効率が向上する。しかもデータの転送候補となる計算機群の中から最も負荷が小さい計算機を選んでデータを転送しているので、ネットワーク状に接続された計算機１～１０の全体に負荷が平均的に分散され、ライン全体の効率が大きく向上する。

【００２０】本実施例で示した計算機１～１０の配置や接続形態はあくまで一例であって、これらは工場環境や生産規模等に応じて適宜変更される。生産規模の拡大等によってネットワーク接続される計算機資源が増加すれば、それに応じてデータ処理効率も向上する。転送先決定手順も上記に限定されず、例えば各ノードを負荷が軽いものから順位づけした上で、残りの処理数から転送可能なノードを抽出して負荷の順位が高いノードへ転送しても良い。

【００２１】本実施例では、特にデータ転送先の決定時に先行節から後行節へと経路を形成するようにしたが、残る処理数とノード数との関係によっては、後行節から先行節へ戻るような経路を選ぶこともあり得る。また、データ変換の分割数も実施例に限定されず、例えば２番目の単位処理Ｕ２をさらに細分化するなど、計算機資源の数や配置等に応じて適宜変更してよい。さらに、実施例では電子ビーム露光装置を例に挙げて説明したが、本発明はイオンビームを用いる露光装置にも適用できる。

【００２２】

【発明の効果】以上説明したように、本発明では、設計支援装置と荷電粒子線露光装置との間をネットワーク状に結ぶ計算機資源の間でデータを転送しつつデータ変換を進めるので、データ変換用の計算機で集中的にデータを変換する従来例と比較してデータの入出力時間が省略されるとともに、複数のデータをパイプライン式に並列処理できるので、データ変換効率が向上する。しかも、負荷の小さい計算機資源をデータ転送先として選択するので、設計支援装置から荷電粒子線露光装置に至る各計算機資源の負荷を平均的に分散させてライン全体の効率を向上させることができる。ネットワーク上にエンジニアリングワークステーション等の強力な計算機資源が接

続されている環境であれば、処理効率の向上に顕著な効果が期待できる。

【図面の簡単な説明】

【図1】本発明の一実施例でのデータ変換処理の分割態様を示す図。

【図2】本発明の実施例におけるデータ変換・転送手順を示すフローチャート。

【図3】本発明の実施例におけるデータ転送先の決定手順を説明するための図。

【図4】本発明の実施例における計算機資源の配置を示す図。

【図5】図4の各計算機資源が備える機能のブロック図。

【図6】露光処理データの作成から露光までの処理の流れを示すフローチャート。

【符号の説明】

1，2，3　CAD計算機（設計支援装置）

4，5，6　電子ビーム露光装置（荷電粒子線露光装置）

7，8　露光用データ管理計算機

9，10　生産ライン管理計算機

11，15　イーサネット

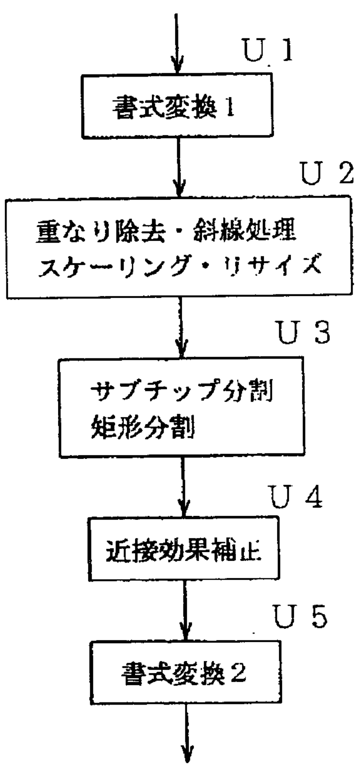
12，16　ブリッジ

13　イーサネット幹線

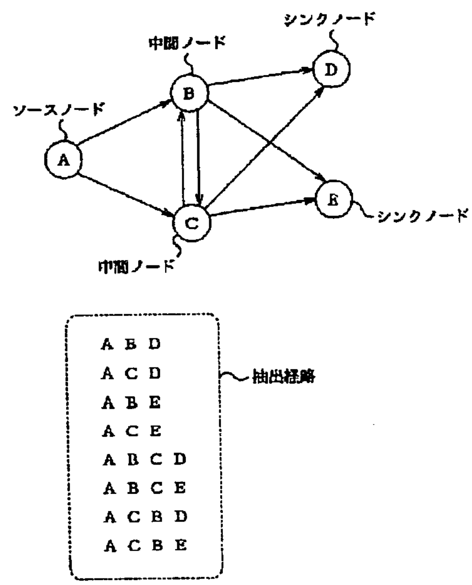
14　VMEバス

U1～U5　単位処理

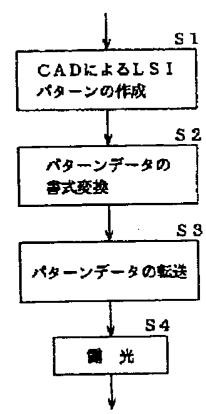
【図1】



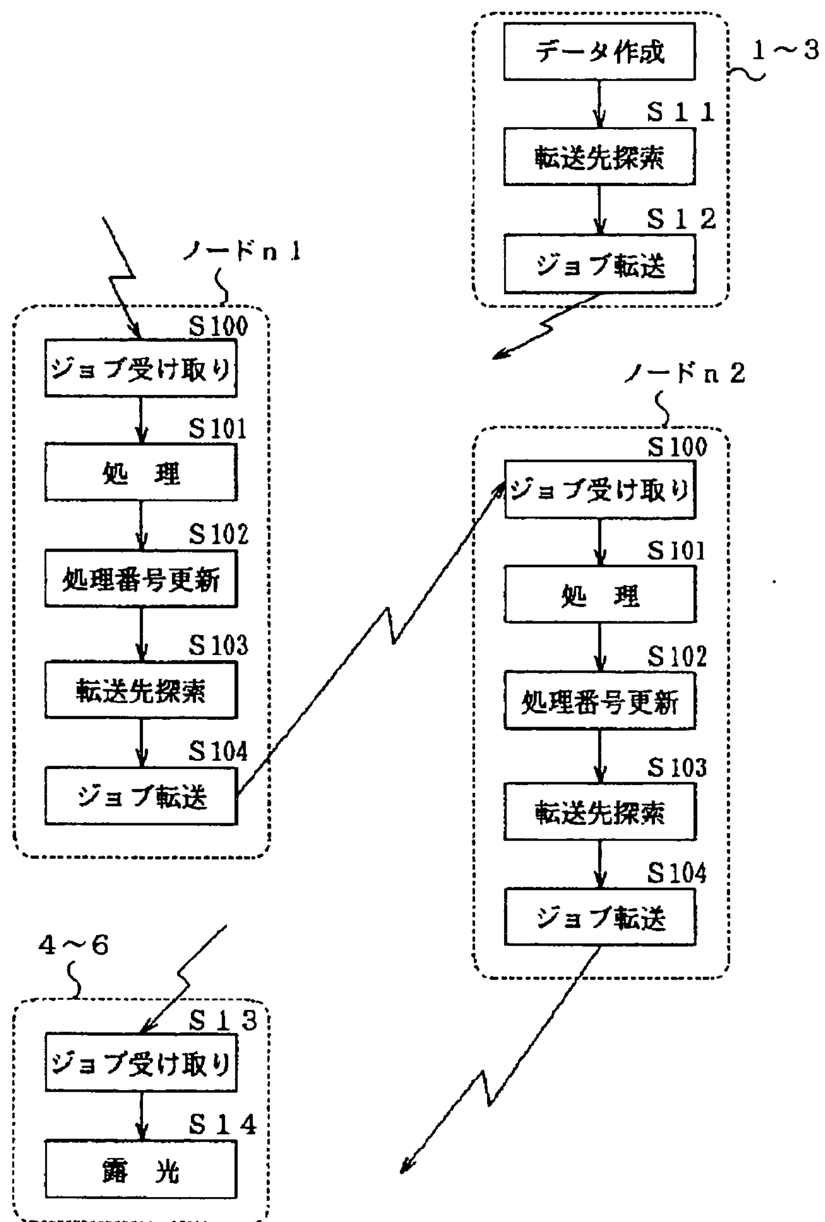
【図3】



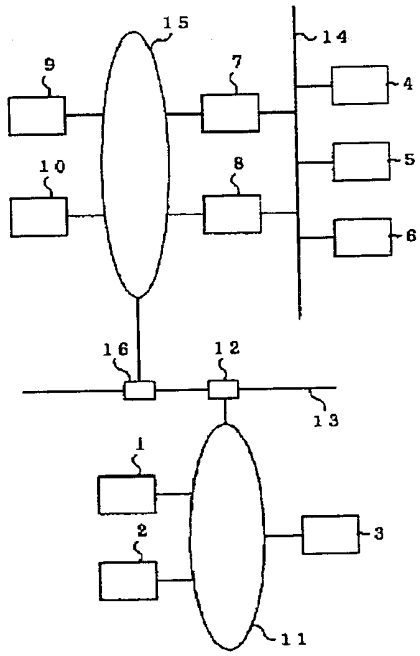
【図6】



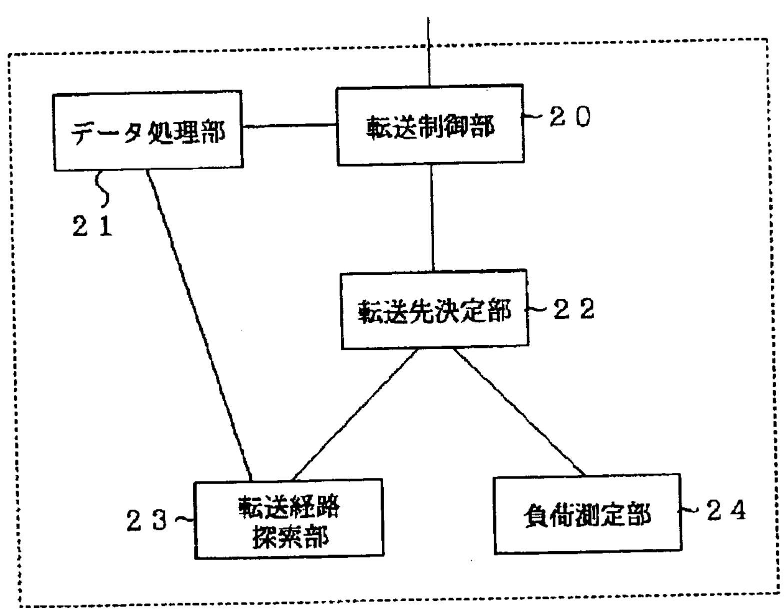
【図2】


データ作成
S11
転送先探索
S12
ジョブ転送
1～3
ノードn1
S100
ジョブ受け取り
S101
処　理
S102
処理番号更新
S103
転送先探索
S104
ジョブ転送
ノードn2
S100
ジョブ受け取り
S101
処　理
S102
処理番号更新
S103
転送先探索
S104
ジョブ転送
4～6
S13
ジョブ受け取り
S14
露　光

【図4】


15
14
9
7
4
10
8
5
6
16
12
13
1
2
3
11

【図5】


データ処理部
21
転送制御部
20
転送先決定部
22
転送経路
探索部
23
負荷測定部
24

* NOTICES *

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damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] It is the data-conversion approach of the charged-particle line aligner which changes the exposure processed data created with design exchange equipment into activation data for a charged-particle line aligner to perform exposure processing. With two or more computer resources which divided the data-conversion process from said exposure processed data to said activation data into the unit processing which plurality followed, and were connected in the shape of a network between said design exchange equipment and said charged-particle line aligner Performing said divided unit processing in order, data are transmitted and activation data are supplied to said charged-particle line aligner. At the time of said data transfer The data-conversion approach of the charged-particle line aligner characterized by specifying the calculating-machine resource which should perform the next unit processing based on the number of unit processings, the arrangement of each computer resource, and the load which were left behind, and transmitting data to the calculating-machine resource concerned.

[Claim 2] The data-conversion approach of the charged-particle line aligner characterized by select the computer resource group which serve as a transfer candidate based on the number of unit processings and the arrangement of each computer resource which be left behind , compare the load of each calculating-machine resource in this calculating-machine resource group at the time of said data transfer , and transmit data to a calculating-machine resource with a small load .

[Claim 3] The data-conversion approach of the charged-particle line aligner according to claim 1 or 2 characterized by carrying out transfer control so that said activation data may be stored in the buffer memory of said charged-particle line aligner.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the approach of changing the exposure processed data created with design exchange equipment into the data suitable for the charged-particle line aligner represented by the electron beam machine.
[0002]
[Description of the Prior Art] When exposing an LSI pattern on a sample with an electron beam machine based on the pattern data created by the CAD system for an LSI design, the activity which transforms the format of the pattern data created by the CAD system into the format of the data which an electron beam machine requires is required. Drawing 6 is a flow chart which shows an example of the procedure from creation of pattern data to exposure. In this example, pattern data are created by the CAD system at step S1, the format of pattern data is transformed into the format for electron beam machines by the calculating machine for the CAD system itself or data conversion at step S2, the pattern data after conversion are put in block at step S3, and it transmits to an aligner. The transmitted data are stored in the buffer memory of an aligner, and exposure processing is performed by step S4.
[0003] Here, in exposing with an electron beam machine, in order to raise the precision of an exposure pattern, it is carried out by amendment processing peculiar to electron beam machines, such as amendment of resizing of line breadth, a scaling, and the proximity effect, bundling up at the time of format conversion (step S2), these amendment processings and the format conversion mentioned above are synthesized, and, generally it is called data conversion of pattern data. It is usually to divide this data conversion into some phases, and to be processed, and the calculating machine for data conversion carries out batch transfer of the data to an aligner, when data are written in to an intermediate file and all processings are completed, whenever data-conversion processing carries out fixed phase advance. On these specifications, exposure processed data and the data after data conversion are called activation data, and data before performing data conversion are distinguished.
[0004]
[Problem(s) to be Solved by the Invention] As mentioned above, when the specific calculating machine for data conversion performs data conversion intensively, since there is much amount of data of the pattern data of LSI, about data, the I/O time for reading writing or data to an intermediate file becomes remarkably long compared with data-conversion time amount, and the effectiveness of data-conversion processing becomes very low. Incidentally, it was not rare that data I/O time became about 4 times of data-conversion time amount, either. While an electron beam machine is excellent in drawing of a detailed pattern, it is used for exposure of small quantity many forms, such as the dedication LSI for specified uses, a prototype of a tip device, or a mask, exposure of a reticle used with the aligner of a package method, from the property that the exposure time becomes long, in many cases. For this reason, data conversion from exposure processed data to activation data is performed frequently, and the overhead by the data I/O time mentioned above reduces remarkably the effectiveness of whole Rhine in which it results [from a CAD system] in an aligner.
[0005] The purpose of this invention is to offer the data-conversion approach which may raise the effectiveness of whole Rhine until it performs efficiently conversion to activation data from exposure processed data and results [from the design exchange equipment for exposure processed-data creation] in an aligner.
[0006]
[Means for Solving the Problem] When it explains with reference to drawing 1 and drawing 4 which show one example, in this invention The data-conversion process from exposure processed data to activation data is divided into the unit processings U1-U5 which plurality followed. Processing in order each unit processings U1-U5 divided with two or more calculating-machine resources 1-10 connected in the shape of a network between the design exchange equipments 1-3 and the charged-particle line aligners 4-6, data are transmitted and activation data are supplied to the charged-particle line aligners 4-6. And at the time of a data transfer, the purpose mentioned above is attained by specifying the calculating-machine resource which should perform the next unit processing based on the number of unit processings, the arrangement of each computer resources 1-10, and the load which remain, and transmitting data to the calculating-machine resource concerned. As the specific approach of a computer resource that data should be transmitted, the approach of selecting the computer resource group which serves as a transfer candidate based on the number of unit processings and the arrangement of computer resources 1-10 which were left behind, comparing the load of each calculating-machine resource in this calculating-machine resource group, and transmitting data to a calculating-machine resource with a small load can be used like the conversion approach of claim 2. The changed

activation data are storable in the buffer memory of the charged-particle line aligners 4-6 like the publication to claim 3.

[0007]

[Function] Being changed towards activation data in order according to the unit processings U1-U5 into which these exposure processed data were divided, if exposure processed data are created with the design exchange equipments 1-3 It is transmitted among the calculating-machine resources 1-10 to which between the design exchange equipments 1-3 and the charged-particle line aligners 4-6 is connected in the shape of a network, and, finally activation data are supplied to the charged-particle line aligners 4-6. Since a calculating-machine resource with a small load is chosen as the data transfer point, the load of each computer resource from the design exchange equipments 1-3 to the charged-particle line aligners 4-6 is distributed on the average.

[0008] In addition, although drawing of an example was used by the term of above-mentioned The means for solving a technical problem explaining the configuration of this invention, and an operation in order to make this invention intelligible, thereby, this invention is not limited to an example.

[0009]

[Example] Hereafter, one example of this invention is explained with reference to drawing 1 - drawing 5 . Drawing 4 shows the lithography production line for the LSI pattern formation concerning this example. This production line is equipped with three CAD calculating machines 1-3 which create exposure processed data, three electron beam machines 4-6 which perform exposure processing, two data control calculating machines 7 and 8 for exposure which manage many data required in order to expose with these electron beam machines 4-6, and two production-line management calculating machines 9 and 10 which manage the whole production line. Although the data control calculating machines 7 and 8 for exposure are constituted by the general-purpose workstation carrying database engine, they may be made to serve a double purpose with the production-line management calculating machines 9 and 10 or the control unit of four to electron-beam-machine 6 self.

[0010] The CAD calculating machines 1-3 are connected to the Ethernet trunk 13 through a bridge 12 while it is installed in the design room which is distant from a production site and Ethernet 11 connects mutually. On the other hand, electron beam machines 4-6 are installed in the clean room of a production site, and it connects mutually by VME bus 14 between each buffer memory and the data control calculating machines 7 and 8 for exposure. The data control computers 7 and 8 for exposure and the production-line management computers 9 and 10 are connected to the Ethernet trunk 13 through a bridge 16 while it is installed in the inside of a clean room, or its perimeter and Ethernet 15 connects mutually. Ten sets of the computer resources of the CAD calculating machines 1-3, electron beam machines 4-6, the data control calculating machines 7 and 8 for exposure, and the production-line management calculating machines 9 and 10 are mutually connected in the shape of a network by the above.

[0011] Each calculating machines 1-10 are equipped with the logical organization shown in drawing 5 in order to change exposure processed data. In drawing, 20 is a transfer control section which controls delivery of the data between the calculating machines 1-10 connected in the shape of a network. If this transfer control section 20 receives data, data will be supplied to the data-processing section 21, and desired processing will be performed among the data-conversion processings mentioned later. The data processed in the data-processing section 21 are transmitted to the destination determined by the transfer control section 20 in the destination decision section 22. The destination decision section 22 determines the destination based on the transfer path for which the transfer path planning section 23 searched, and the load of the computers 1-10 which the load test section 24 measured. The transfer path planning section 23 searches for a transfer path based on the topology of calculating machines 1-10, and the remaining unit number of processing supplied from the data-processing section 21. The load test section 24 measures the load of each computers 1-10 from the operating ratio in fixed time amount of CPU of computers 1-10.

[0012] Next, the data-conversion procedure of this example is explained with reference to drawing 1 - drawing 3 . In this example, the processing for changing the exposure processed data created with either of the CAD calculating machines 1-3 into the activation data which electron beam machines 4-6 require is divided into the unit processings U1-U5 which plurality followed as shown in drawing 1 . The format of the exposure processed data created by the CAD calculating machines 1-3 in the first unit processing U1 is transformed into the format suitable for data conversion, lap removal of a pattern, slash processing, a scaling, and resizing are performed in the 2nd unit processing U2, subchip division and rectangle division of a pattern are performed in the 3rd unit processing U3, and proximity effect correction is performed in the 4th unit processing U4. And the format of the changed data is transformed into the format which aligners 4-6 require in the last unit processing U5. One activity which consists of these unit processings U1-U5 is called a job. A processing number is set up as a parameter which shows the advance situation of a job, and matching with this processing number and the unit processings U1-U5 mentioned above is unified and shared by this example by

each computers (it is also called a node below) 1-10. For example, if the node of arbitration receives the job of a processing number "001", unit processing U1 will be performed, and if the job of a processing number "004" is received, the definition unified into each node so that unit processing U4 might be performed will be given.
[0013] The flow of processing of a job is shown in drawing 2 . Processing of a job will be started if exposure processed data are created with either of the CAD calculating machines 1-3. The CAD computers 1-3 which created exposure processed data perform destination retrieval processing later mentioned at step S11, and transmit a job to the destination determined at step S12. The processing number mentioned above at this time is set as the number corresponding to the first unit processing U1.
[0014] The node n1 of the destination receives a job at step S100 first. Subsequently, unit processing corresponding to the processing number of the job received at step S101 is performed, and a processing number is updated to the processing number corresponding to the next unit processing at step S102. And step S103 is searched for the destination and a job is transmitted at step S104. If data conversion and a transfer are repeated similarly and data conversion advances to the last unit processing U5 until the node n2 of the new destination performs processing from a job receipt to a job transfer like the previous node n1 and the last unit processing U5 is completed below, a job will be transmitted to either of the aligners 4-6. Step S13 performed with the aligners 4-6 which are the final destinations means storing in buffer memory, and performs exposure processing at step S14.
[0015] The above-mentioned destination retrieval processing is explained based on drawing 3 and drawing 5 . Drawing 3 shows the condition that a job is completed, with a directed graph, when data-conversion processing performs the phase U3-U5 which finished the unit processing U2, i.e., three more unit processings. Each node is classified into the source node A, intermediate nodes B and C, and sink nodes D and E by the function. The source node A is a node which owns the job at present, and exists only one per job. For example, in the phase which created exposure processed data by the CAD calculating machine 1, CAD calculating-machine 1 self serves as the source node A. Sink nodes D and E are the last arrival points of a job, and electron beam machines 4-6 and the more detailed buffer memory for the pattern data storage of aligners 4-6 correspond in this example. The node except the source node A and sink nodes D and E turns into intermediate nodes B and C, and a multi-statement is possible for these intermediate nodes B and C and sink nodes D and E.
[0016] In order to determine the destination from the condition of drawing 3 , first, the transfer path planning section 23 of the source node A judges the unit number of processing left behind by the processing number of the job sent from the data-processing section 21, and extracts all the paths that can transmit a job to sink nodes D and E by this number of processing and the count of a transfer below the number of processing which remains from arrangement of each node. Under the present circumstances, since it is a directed graph, a path is created so that it may surely be connected from a precedence knot to a backward knot. A well-known algorithm is applicable to this as phase alignment (topological sort).
[0017] Since the remaining unit number of processing is three in the case of drawing 3 , the path which reaches sink nodes D and E by two transfers, and the path which reaches sink nodes D and E by three transfers are extracted. As the former, four paths of ABD, ABE, ACD, and ACE are extracted, and four paths of ABCD, ABCE, ACBD, and ACBE are extracted as the latter. Here, the paths ABD, ABE, ACD, and ACE which reach sink nodes D and E by two transfers mean transmitting a job to oneself by one on a path of nodes. If it becomes path ABD, processing of data and a transfer will be performed in one path of AABD, ABBD, and ABDD in fact.
[0018] If the above path extract is finished, the example of the node group and drawing which serve as a transfer candidate among the loads of each node measured by the load test section 24 of the source node A will compare the load of Nodes A, B, and C mutually in the destination decision section 22. And a node with the smallest load is determined as the destination, and from the transfer control section 20, the job processed in the data-processing section 21 is turned to the destination, and is sent out.
[0019] When it compares with the conventional example which transmits data collectively after the specific calculating machine performed data conversion intensively since data are transmitted and it goes by this example towards electron beam machines 4-6 from the CAD calculating machines 1-3, performing divided unit processings U1-U5 in order, the I/O time of data does not turn into a dead time, but data-conversion effectiveness increases. Moreover, since the parallel processing of two or more data can be carried out to a pipeline type as creation and data-conversion processing of new exposure processed data can be performed by the CAD calculating machines 1-3, after transmitting data to the calculating machines 7-10 which adjoin, for example from the CAD calculating machines 1-3, the effectiveness of whole Rhine improves. And since the calculating machine with the smallest load was chosen from the calculating-machine groups which serve as a data transfer candidate and data are transmitted, a load is distributed on the average by the whole calculating machines 1-10 connected in the shape of a network, and the effectiveness of whole Rhine

improves greatly.
[0020] Arrangement and the topology of the computers 1-10 shown by this example are an example to the last, and these are suitably changed according to a works environment, a production scale, etc. If the calculating-machine resource network connection is carried out [a resource] by expansion of a production scale etc. increases, data-processing effectiveness will also improve according to it. After a destination decision procedure was not limited above, either, for example, a load carries out ranking attachment of each node from a light thing, the node which can be transmitted from the remaining number of processing may be extracted, and the ranking of a load may transmit to a high node.
[0021] Especially in this example, although the path was formed in the backward knot from the precedence knot at the time of the decision of the data transfer point, a path which returns from a backward knot to a precedence knot depending on the relation of the number of processing and the number of nodes which remain can be chosen. Moreover, the number of partitions of data conversion is not limited to an example, either, for example, subdividing further etc. may change the 2nd unit processing U2 suitably according to the number of computer resources, arrangement, etc. Furthermore, although the electron beam machine was mentioned as the example and the example explained it, this invention is applicable also to the aligner which uses an ion beam.
[0022]
[Effect of the Invention] Since the parallel processing of two or more data can be carried out to a pipeline type while the I/O time of data is omitted by the calculating machine for data conversion as compared with the conventional example which changes data intensively, since data conversion is advanced transmitting data between the calculating machine resources to which between design exchange equipment and charged particle line aligners is connected with this invention in the shape of a network as explained above, data conversion effectiveness improves. And since the small calculating-machine resource of a load is chosen as the data transfer point, the load of each computer resource from design exchange equipment to a charged-particle line aligner can be distributed on the average, and the effectiveness of whole Rhine can be raised. If it is the environment where powerful computer resources, such as an engineering workstation, are connected on the network, effectiveness remarkable in improvement in processing effectiveness is expectable.

[Translation done.]

TECHNICAL FIELD

[Industrial Application] This invention relates to the approach of changing the exposure processed data created with design exchange equipment into the data suitable for the charged-particle line aligner represented by the electron beam machine.

[Translation done.]

.PRIOR ART

[Description of the Prior Art] When exposing an LSI pattern on a sample with an electron beam machine based on the pattern data created by the CAD system for an LSI design, the activity which transforms the format of the pattern data created by the CAD system into the format of the data which an electron beam machine requires is required. Drawing 6 is a flow chart which shows an example of the procedure from creation of pattern data to exposure. In this example, pattern data are created by the CAD system at step S1, the format of pattern data is transformed into the format for electron beam machines by the calculating machine for the CAD system itself or data conversion at step S2, the pattern data after conversion are put in block at step S3, and it transmits to an aligner. The transmitted data are stored in the buffer memory of an aligner, and exposure processing is performed by step S4.
[0003] Here, in exposing with an electron beam machine, in order to raise the precision of an exposure pattern, it is carried out by amendment processing peculiar to electron beam machines, such as amendment of resizing of line breadth, a scaling, and the proximity effect, bundling up at the time of format conversion (step S2), these amendment processings and the format conversion mentioned above are synthesized, and, generally it is called data conversion of pattern data. It is usually to divide this data conversion into some phases, and to be processed, and the calculating machine for data conversion carries out batch transfer of the data to an aligner, when data are written in to an intermediate file and all processings are completed, whenever data-conversion processing carries out fixed phase advance. On these specifications, exposure processed data and the data after data conversion are called activation data, and data before performing data conversion are distinguished.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] Since the parallel processing of two or more data can be carried out to a pipeline type while the I/O time of data is omitted by the calculating machine for data conversion as compared with the conventional example which changes data intensively, since data conversion is advanced transmitting data between the calculating machine resources to which between design exchange equipment and charged particle line aligners is connected with this invention in the shape of a network as explained above, data conversion effectiveness improves. And since the small calculating-machine resource of a load is chosen as the data transfer point, the load of each computer resource from design exchange equipment to a charged-particle line aligner can be distributed on the average, and the effectiveness of whole Rhine can be raised. If it is the environment where powerful computer resources, such as an engineering workstation, are connected on the network, effectiveness remarkable in improvement in processing effectiveness is expectable.

[Translation done.]

.TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] As mentioned above, when the specific calculating machine for data conversion performs data conversion intensively, since there is much amount of data of the pattern data of LSI, about data, the I/O time for reading writing or data to an intermediate file becomes remarkably long compared with data-conversion time amount, and the effectiveness of data-conversion processing becomes very low. Incidentally, it was not rare that data I/O time became about 4 times of data-conversion time amount, either. While an electron beam machine is excellent in drawing of a detailed pattern, it is used for exposure of small quantity many forms, such as the dedication LSI for specified uses, a prototype of a tip device, or a mask, exposure of a reticle used with the aligner of a package method, from the property that the exposure time becomes long, in many cases. For this reason, data conversion from exposure processed data to activation data is performed frequently, and the overhead by the data I/O time mentioned above reduces remarkably the effectiveness of whole Rhine in which it results [from a CAD system] in an aligner.
[0005] The purpose of this invention is to offer the data-conversion approach which may raise the effectiveness of whole Rhine until it performs efficiently conversion to activation data from exposure processed data and results [from the design exchange equipment for exposure processed-data creation] in an aligner.

[Translation done.]

MEANS

[Means for Solving the Problem] When it explains with reference to drawing 1 and drawing 4 which show one example, in this invention The data-conversion process from exposure processed data to activation data is divided into the unit processings U1-U5 which plurality followed. Processing in order each unit processings U1-U5 divided with two or more calculating-machine resources 1-10 connected in the shape of a network between the design exchange equipments 1-3 and the charged-particle line aligners 4-6, data are transmitted and activation data are supplied to the charged-particle line aligners 4-6. And at the time of a data transfer, the purpose mentioned above is attained by specifying the calculating-machine resource which should perform the next unit processing based on the number of unit processings, the arrangement of each computer resources 1-10, and the load which remain, and transmitting data to the calculating-machine resource concerned. As the specific approach of a computer resource that data should be transmitted, the approach of selecting the computer resource group which serves as a transfer candidate based on the number of unit processings and the arrangement of computer resources 1-10 which were left behind, comparing the load of each calculating-machine resource in this calculating-machine resource group, and transmitting data to a calculating-machine resource with a small load can be used like the conversion approach of claim 2. The changed activation data are storable in the buffer memory of the charged-particle line aligners 4-6 like the publication to claim 3.

[Translation done.]

.OPERATION

[Function] If exposure processed data are created with the design exchange equipments 1-3, while being changed towards activation data in order according to the unit processings U1-U5 into which these exposure processed data were divided, It is transmitted among the calculating-machine resources 1-10 to which between the design exchange equipments 1-3 and the charged-particle line aligners 4-6 is connected in the shape of a network, and, finally activation data are supplied to the charged-particle line aligners 4-6. Since a calculating-machine resource with a small load is chosen as the data transfer point, the load of each computer resource from the design exchange equipments 1-3 to the charged-particle line aligners 4-6 is distributed on the average.
[0008] In addition, although drawing of an example was used by the term of above-mentioned The means for solving a technical problem explaining the configuration of this invention, and an operation in order to make this invention intelligible, thereby, this invention is not limited to an example.

[Translation done.]

EXAMPLE

[Example] Hereafter, one example of this invention is explained with reference to drawing 1 - drawing 5 . Drawing 4 shows the lithography production line for the LSI pattern formation concerning this example. This production line is equipped with three CAD calculating machines 1-3 which create exposure processed data, three electron beam machines 4-6 which perform exposure processing, two data control calculating machines 7 and 8 for exposure which manage many data required in order to expose with these electron beam machines 4-6, and two production-line management calculating machines 9 and 10 which manage the whole production line. Although the data control calculating machines 7 and 8 for exposure are constituted by the general-purpose workstation carrying database engine, they may be made to serve a double purpose with the production-line management calculating machines 9 and 10 or the control unit of four to electron-beam-machine 6 self.

[0010] The CAD calculating machines 1-3 are connected to the Ethernet trunk 13 through a bridge 12 while it is installed in the design room which is distant from a production site and Ethernet 11 connects mutually. On the other hand, electron beam machines 4-6 are installed in the clean room of a production site, and it connects mutually by VME bus 14 between each buffer memory and the data control calculating machines 7 and 8 for exposure. The data control computers 7 and 8 for exposure and the production-line management computers 9 and 10 are connected to the Ethernet trunk 13 through a bridge 16 while it is installed in the inside of a clean room, or its perimeter and Ethernet 15 connects mutually. Ten sets of the computer resources of the CAD calculating machines 1-3, electron beam machines 4-6, the data control calculating machines 7 and 8 for exposure, and the production-line management calculating machines 9 and 10 are mutually connected in the shape of a network by the above.

[0011] Each calculating machines 1-10 are equipped with the logical organization shown in drawing 5 in order to change exposure processed data. In drawing, 20 is a transfer control section which controls delivery of the data between the calculating machines 1-10 connected in the shape of a network. If this transfer control section 20 receives data, data will be supplied to the data-processing section 21, and desired processing will be performed among the data-conversion processings mentioned later. The data processed in the data-processing section 21 are transmitted to the destination determined by the transfer control section 20 in the destination decision section 22. The destination decision section 22 determines the destination based on the transfer path for which the transfer path planning section 23 searched, and the load of the computers 1-10 which the load test section 24 measured. The transfer path planning section 23 searches for a transfer path based on the topology of calculating machines 1-10, and the remaining unit number of processing supplied from the data-processing section 21. The load test section 24 measures the load of each computers 1-10 from the operating ratio in fixed time amount of CPU of computers 1-10.

[0012] Next, the data-conversion procedure of this example is explained with reference to drawing 1 - drawing 3 . In this example, the processing for changing the exposure processed data created with either of the CAD calculating machines 1-3 into the activation data which electron beam machines 4-6 require is divided into the unit processings U1-U5 which plurality followed as shown in drawing 1 . The format of the exposure processed data created by the CAD calculating machines 1-3 in the first unit processing U1 is transformed into the format suitable for data conversion, lap removal of a pattern, slash processing, a scaling, and resizing are performed in the 2nd unit processing U2, subchip division and rectangle division of a pattern are performed in the 3rd unit processing U3, and proximity effect correction is performed in the 4th unit processing U4. And the format of the changed data is transformed into the format which aligners 4-6 require in the last unit processing U5. One activity which consists of these unit processings U1-U5 is called a job. A processing number is set up as a parameter which shows the advance situation of a job, and matching with this processing number and the unit processings U1-U5 mentioned above is unified and shared by this example by each computers (it is also called a node below) 1-10. For example, if the node of arbitration receives the job of a processing number "001", unit processing U1 will be performed, and if the job of a processing number "004" is received, the definition unified into each node so that unit processing U4 might be performed will be given.

[0013] The flow of processing of a job is shown in drawing 2 . Processing of a job will be started if exposure processed data are created with either of the CAD calculating machines 1-3. The CAD computers 1-3 which created exposure processed data perform destination retrieval processing later mentioned at step S11, and transmit a job to the destination determined at step S12. The processing number mentioned above at this time is set as the number corresponding to the first unit processing U1.

[0014] The node n1 of the destination receives a job at step S100 first. Subsequently, unit processing corresponding to the processing number of the job received at step S101 is performed, and a processing number is updated to the processing number corresponding to the next unit processing at step S102. And step S103 is searched for the destination and a job is transmitted at step S104. If data conversion and a transfer are repeated similarly and data

conversion advances to the last unit processing U5 until the node n2 of the new destination performs processing from a job receipt to a job transfer like the previous node n1 and the last unit processing U5 is completed below, a job will be transmitted to either of the aligners 4-6. Step S13 performed with the aligners 4-6 which are the final destinations means storing in buffer memory, and performs exposure processing at step S14.

[0015] The above-mentioned destination retrieval processing is explained based on drawing 3 and drawing 5 . Drawing 3 shows the condition that a job is completed, with a directed graph, when data-conversion processing performs the phase U3-U5 which finished the unit processing U2, i.e., three more unit processings. Each node is classified into the source node A, intermediate nodes B and C, and sink nodes D and E by the function. The source node A is a node which owns the job at present, and exists only one per job. For example, in the phase which created exposure processed data by the CAD calculating machine 1, CAD calculating-machine 1 self serves as the source node A. Sink nodes D and E are the last arrival points of a job, and electron beam machines 4-6 and the more detailed buffer memory for the pattern data storage of aligners 4-6 correspond in this example. The node except the source node A and sink nodes D and E turns into intermediate nodes B and C, and a multi-statement is possible for these intermediate nodes B and C and sink nodes D and E.

[0016] In order to determine the destination from the condition of drawing 3 , first, the transfer path planning section 23 of the source node A judges the unit number of processing left behind by the processing number of the job sent from the data-processing section 21, and extracts all the paths that can transmit a job to sink nodes D and E by this number of processing and the count of a transfer below the number of processing which remains from arrangement of each node. Under the present circumstances, since it is a directed graph, a path is created so that it may surely be connected from a precedence knot to a backward knot. A well-known algorithm is applicable to this as phase alignment (topological sort).

[0017] Since the remaining unit number of processing is three in the case of drawing 3 , the path which reaches sink nodes D and E by two transfers, and the path which reaches sink nodes D and E by three transfers are extracted. As the former, four paths of ABD, ABE, ACD, and ACE are extracted, and four paths of ABCD, ABCE, ACBD, and ACBE are extracted as the latter. Here, the paths ABD, ABE, ACD, and ACE which reach sink nodes D and E by two transfers mean transmitting a job to oneself by one on a path of nodes. If it becomes path ABD, processing of data and a transfer will be performed in one path of AABD, ABBD, and ABDD in fact.

[0018] If the above path extract is finished, the example of the node group and drawing which serve as a transfer candidate among the loads of each node measured by the load test section 24 of the source node A will compare the load of Nodes A, B, and C mutually in the destination decision section 22. And a node with the smallest load is determined as the destination, and from the transfer control section 20, the job processed in the data-processing section 21 is turned to the destination, and is sent out.

[0019] When it compares with the conventional example which transmits data collectively after the specific calculating machine performed data conversion intensively since data are transmitted and it goes by this example towards electron beam machines 4-6 from the CAD calculating machines 1-3, performing divided unit processings U1-U5 in order, the I/O time of data does not turn into a dead time, but data-conversion effectiveness increases. Moreover, since the parallel processing of two or more data can be carried out to a pipeline type as creation and data-conversion processing of new exposure processed data can be performed by the CAD calculating machines 1-3, after transmitting data to the calculating machines 7-10 which adjoin, for example from the CAD calculating machines 1-3, the effectiveness of whole Rhine improves. And since the calculating machine with the smallest load was chosen from the calculating-machine groups which serve as a data transfer candidate and data are transmitted, a load is distributed on the average by the whole calculating machines 1-10 connected in the shape of a network, and the effectiveness of whole Rhine improves greatly.

[0020] Arrangement and the topology of the computers 1-10 shown by this example are an example to the last, and these are suitably changed according to a works environment, a production scale, etc. If the calculating-machine resource network connection is carried out [a resource] by expansion of a production scale etc. increases, data-processing effectiveness will also improve according to it. After a destination decision procedure was not limited above, either, for example, a load carries out ranking attachment of each node from a light thing, the node which can be transmitted from the remaining number of processing may be extracted, and the ranking of a load may transmit to a high node.

[0021] Especially in this example, although the path was formed in the backward knot from the precedence knot at the time of the decision of the data transfer point, a path which returns from a backward knot to a precedence knot depending on the relation of the number of processing and the number of nodes which remain can be chosen. Moreover, the number of partitions of data conversion is not limited to an example, either, for example, subdividing

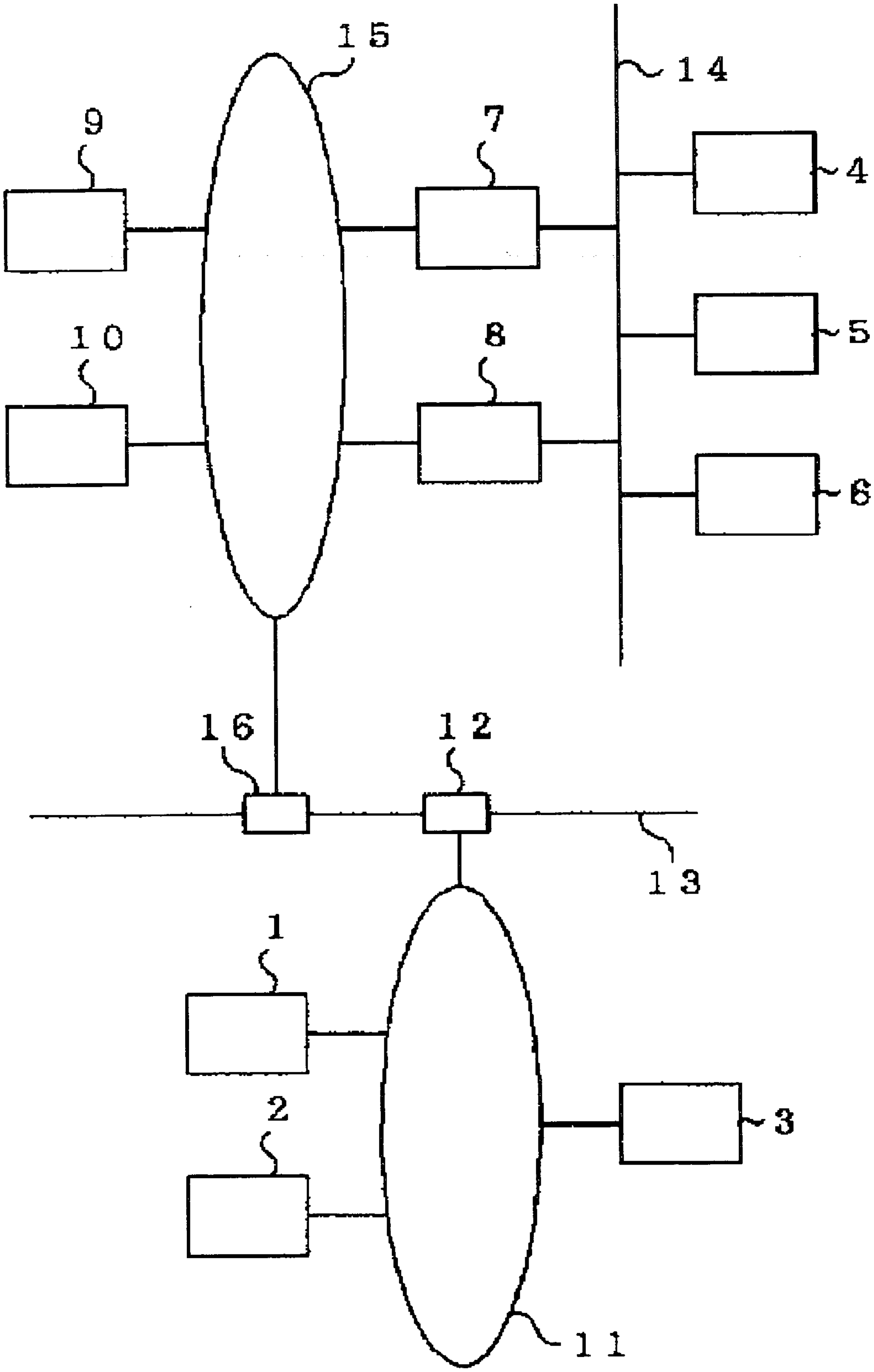
further etc. may change the 2nd unit processing U2 suitably according to the number of computer resources, arrangement, etc. Furthermore, although the electron beam machine was mentioned as the example and the example explained it, this invention is applicable also to the aligner which uses an ion beam.

[Translation done.]

.DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Drawing showing the division mode of data-conversion processing in the one example of this invention.
[Drawing 2] The flow chart which shows data conversion and the transfer procedure in the example of this invention.
[Drawing 3] Drawing for explaining the decision procedure of the data transfer point in the example of this invention.
[Drawing 4] Drawing showing arrangement of the computer resource in the example of this invention.
[Drawing 5] The block diagram of the function with which each calculating-machine resource of drawing 4 is equipped.
[Drawing 6] The flow chart which shows the flow of processing from creation of exposure processed data to exposure.
[Description of Notations]
1, 2, 3 CAD computer (design exchange equipment)
4, 5, 6 Electron beam machine (charged-particle line aligner)
7 Eight Data control computer for exposure
9 Ten Production-line management computer
11 15 Ethernet
12 16 Bridge
13 Ethernet Trunk
14 VME Bus
U1-U5 Unit processing

[Translation done.]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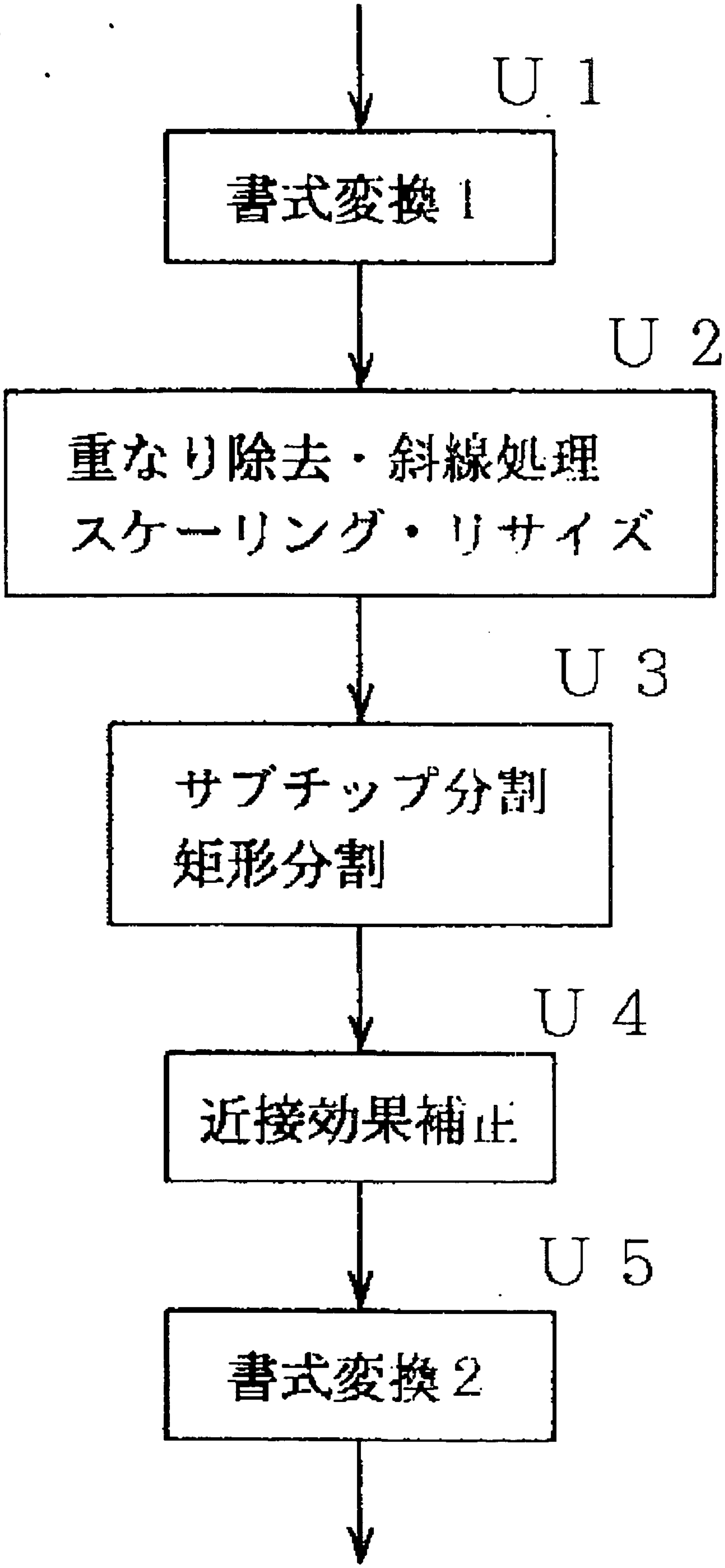
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U 5
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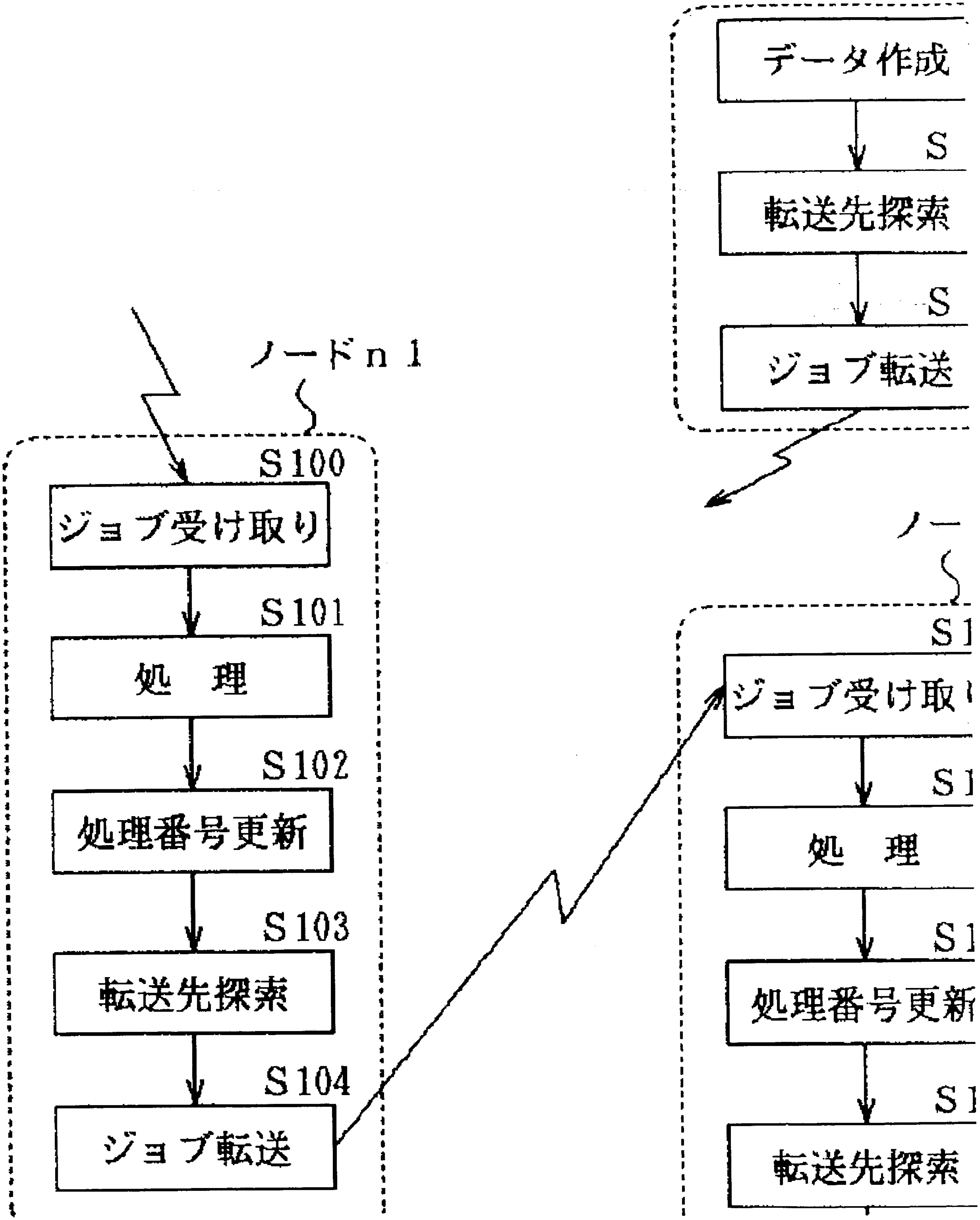
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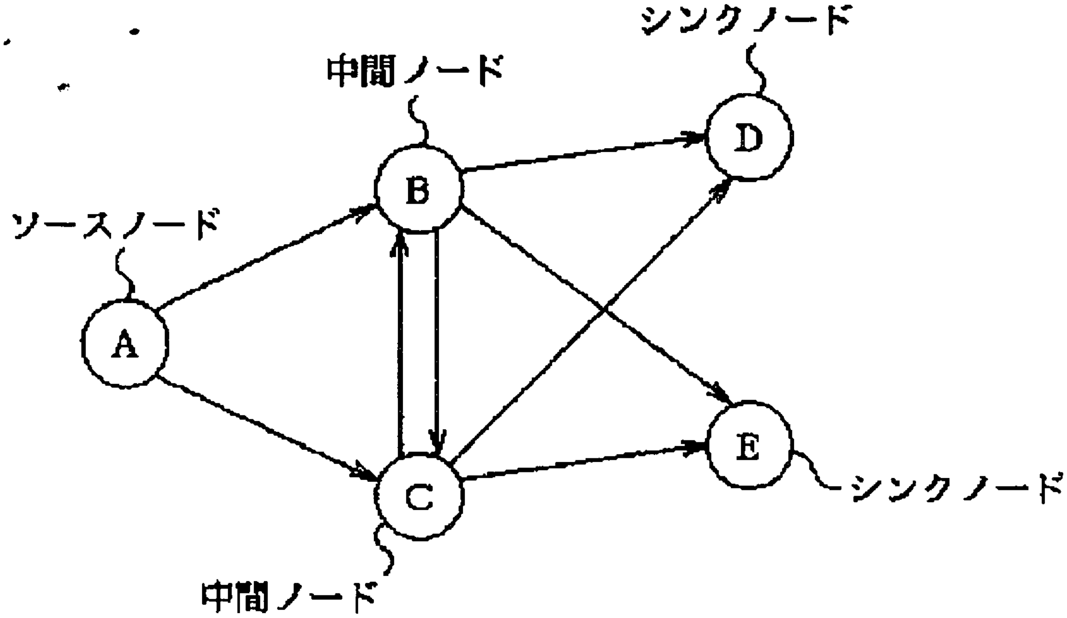

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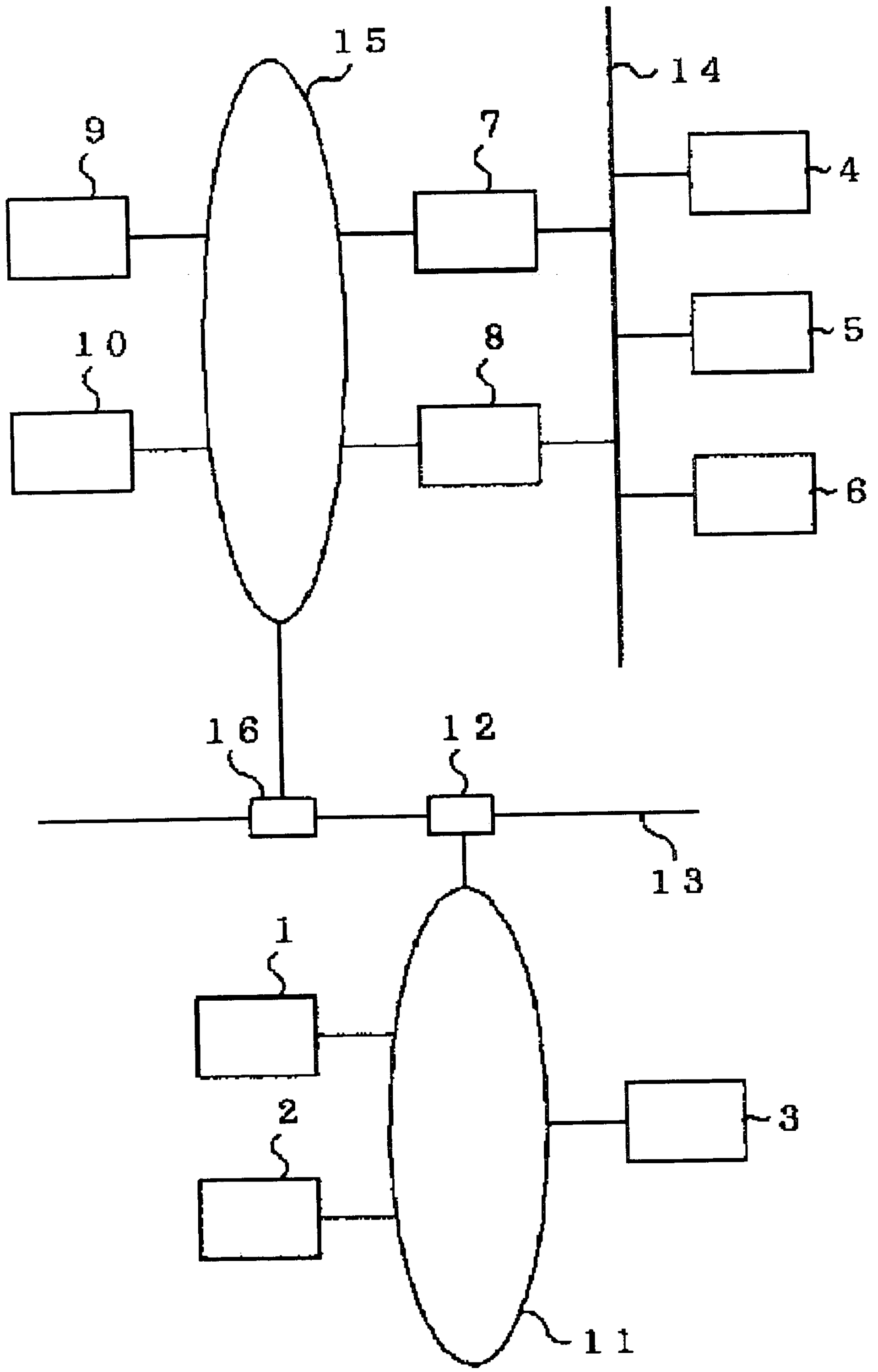
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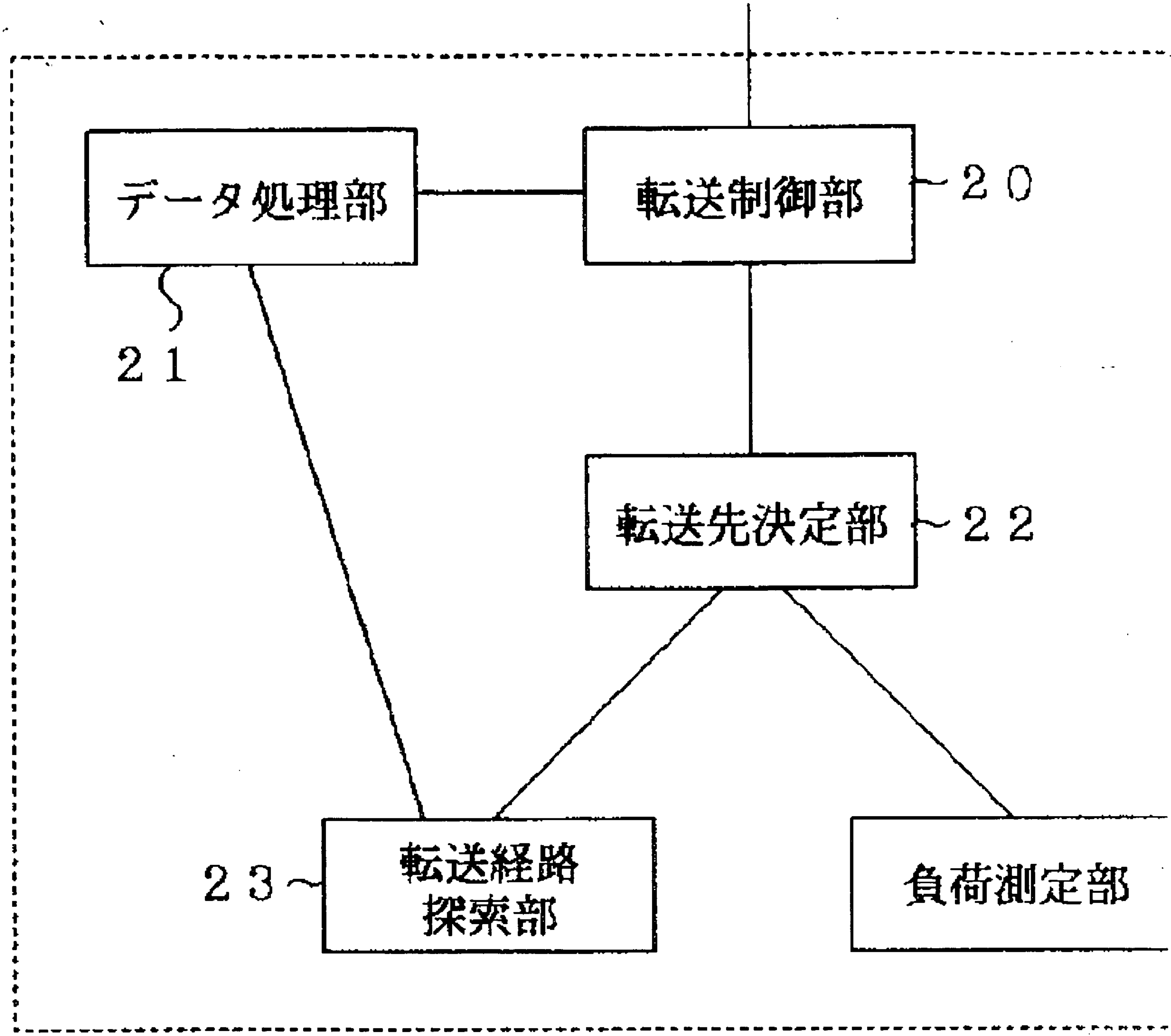
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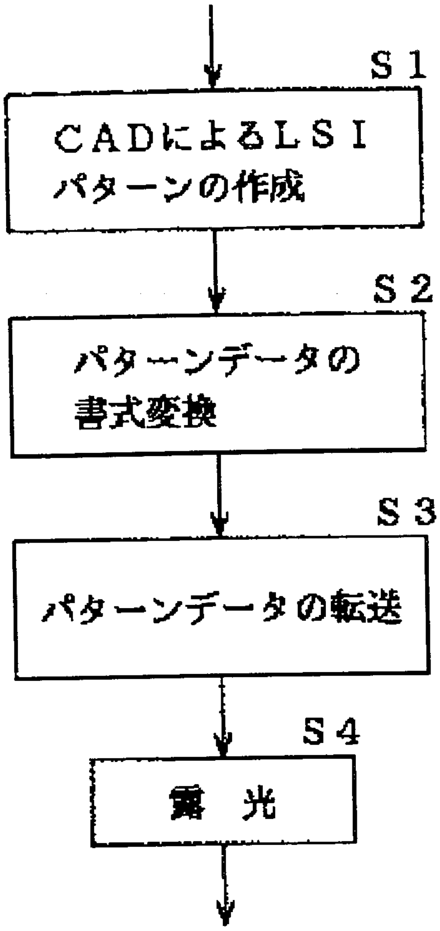
S 1
CADによるLSI
パターンの作成
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パターンデータの
書式変換
S 3
パターンデータの転送
S 4
露　光